Source BIS actuator discussion

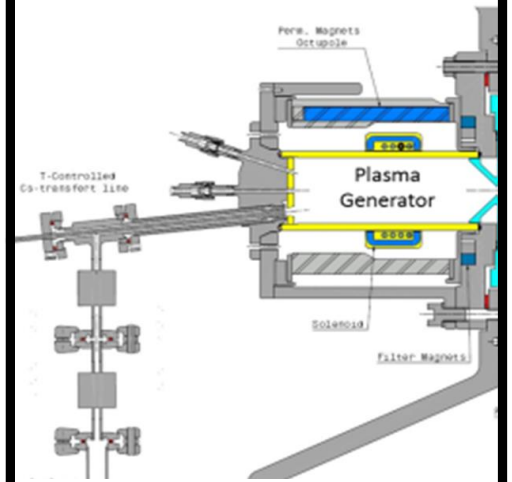
MPP meeting – 01/07/2022

J.B. Lallement for the L4 source team

The H⁻ sources: IS03 and “ISNew”

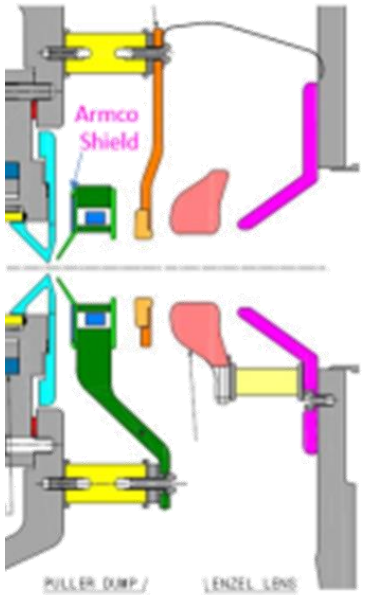
- IS03 is the present operational source.
- Identical plasma generator:
  - Plasma chamber.
  - RF system (amplifier and antenna).
  - Gas injection system.
  - Cesiation system.

- Different extractions and dumping schemes

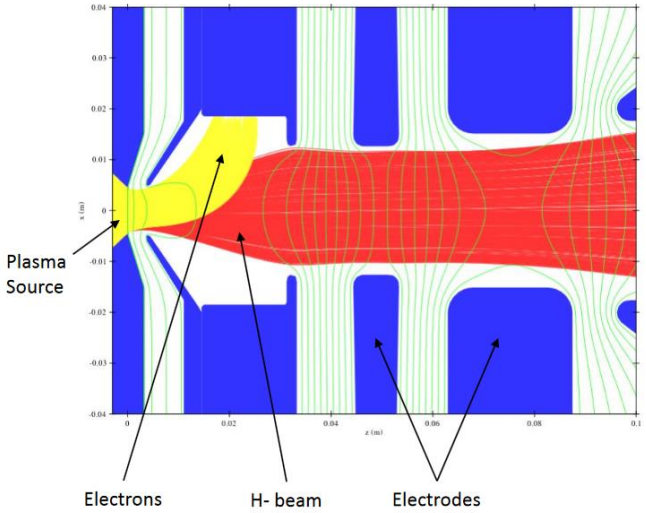


Source Extraction

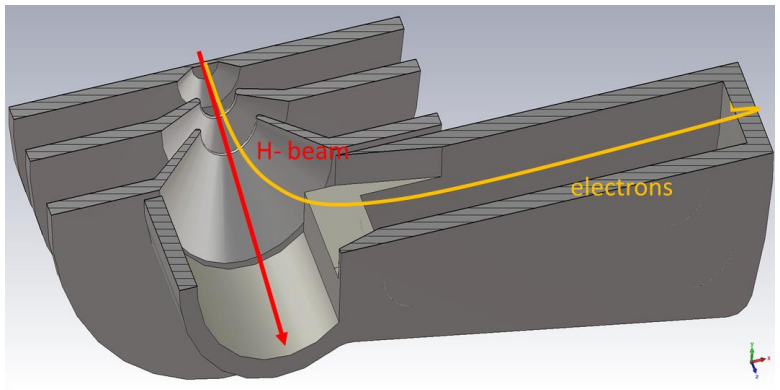
- RFQ injection energy.
- Emittance formation.
- Co-extracted electron dumping.

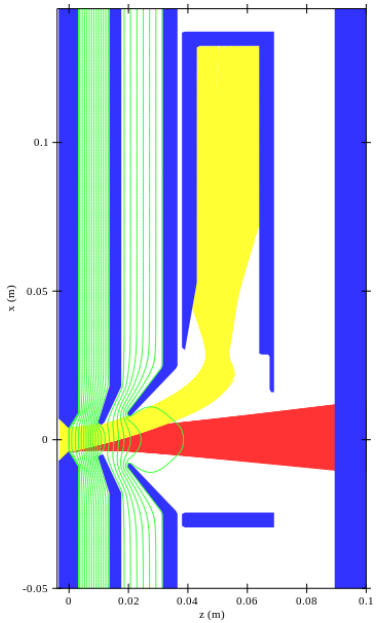


IS03 – Dumping 10 keV e⁻



ISNew – Dumping 45 keV e⁻

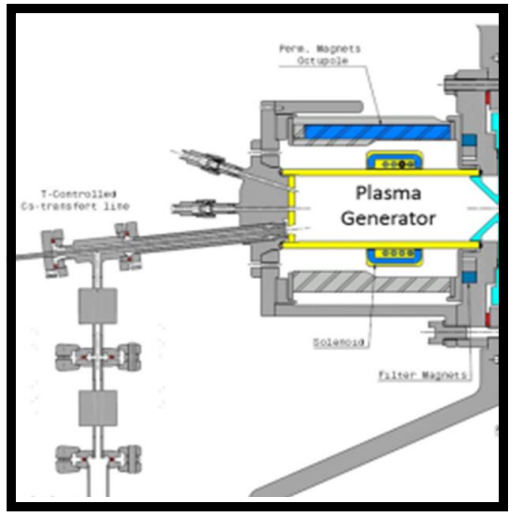


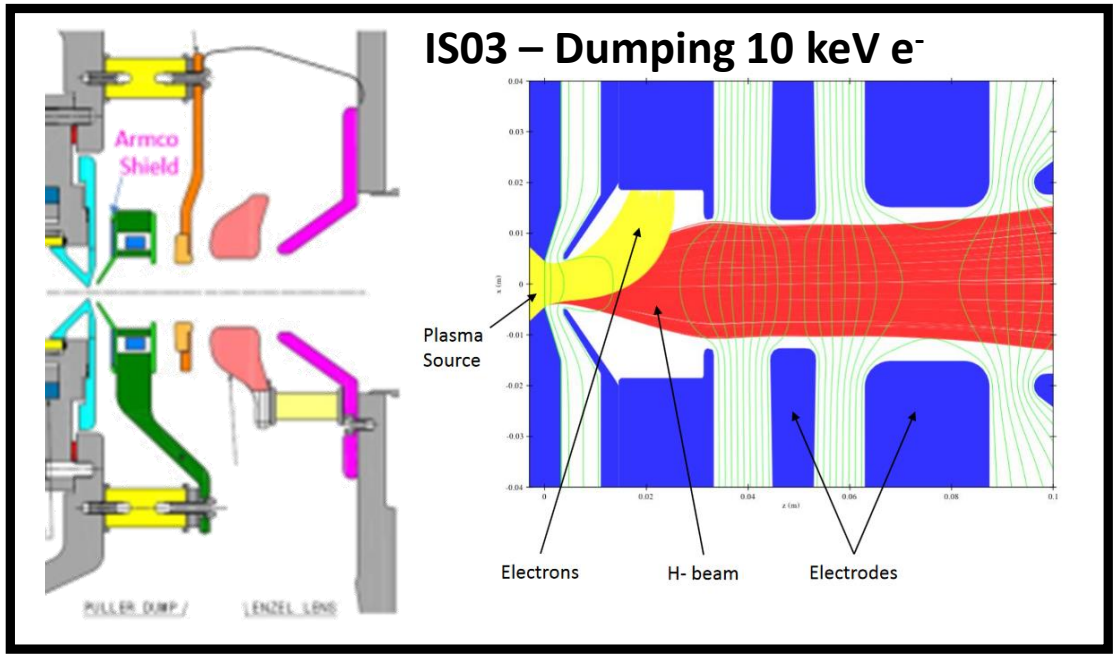


Interlocking the source: 2 possibilities

- The plasma generator produces the particles:
  - An RF pulse sent to the antenna ignites the plasma.
  - No RF, no particles -> as it is today !

- The extraction voltages:
  - Focus the H^- beam.
  - Give 45 keV energy to the beam(s).
  - Make such that e^- are dumped at the right place.
  - No HT, no particles out of the plasma chamber ->
    as proposed some time ago !





Stable Plasma operation means stable source

- Motivation for the change:

The source current stability depends on generator parameters:

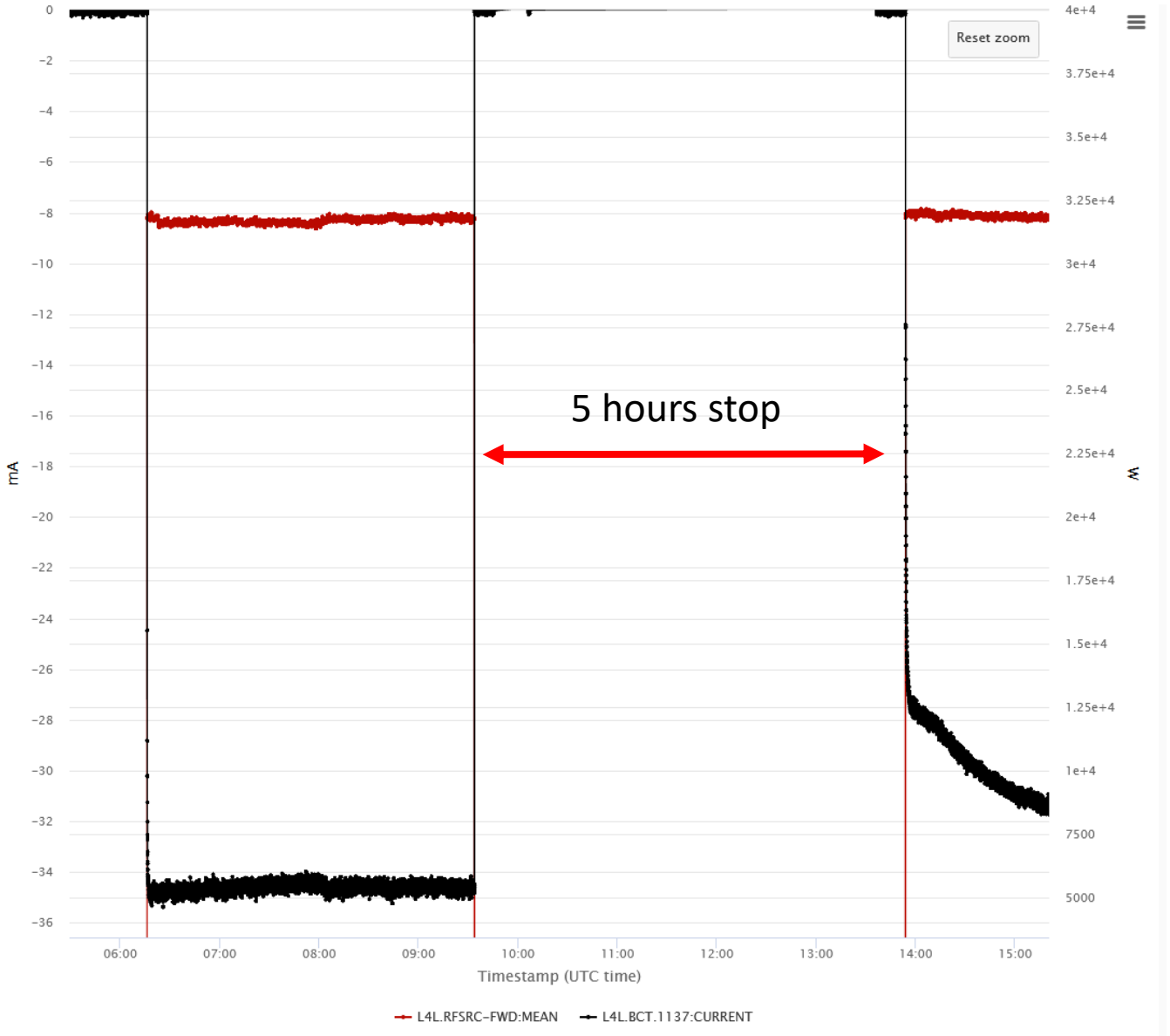
Cs injection
RF power
Gas injection
Temperature

In the absence of RF power, no plasma:

Source cools down
Equilibrium could be temporarily lost

Time to recover depends on the stop duration or stops frequency…

Usually stops for more than 20-30 minutes.



Interlocking with HT

- Main advantage would be to keep the plasma running whatever happens but….
  - HT still needs to be ramped-up to nominal level.
    - HT level should stay in interlocks
    - Not correct HT level means:
      - Beam being lost in first part of the RFQ.
      - Beam being lost inside extraction.
      - e^- being dumped at the wrong place.
      - Possible machine damages.
  - Should an interlock occur:
    - Will get a ramp-down of the field.
    - Not correct HT during that period.
    - Today approx. 500 us, 100 us requiring an upgrade.
    - We could imagine not a single event but repeated until interlocks are cleared.
    - In worst case, HT interlocks generates instabilities on HT, that do not fill interlocks conditions…. etc… etc… etc…
    - The above is valid for present IS03 and could be more problematic with IS04…

After few operation years: Situation is under control

- Whenever long stop due to interlocks.
  - Beam stoppers in clearing the source interlocks: Consigne very well followed.
  - Did not see the source left abandoned for more than 5 minutes because of interlocks.
- After long RF stop independent on interlocks.
  - A recently developed tool Autopilot, insures a smooth restart and helps in producing a stable beam.
  - We run in degraded mode for a period directly link with the duration of the stop (as yesterday).

- In short:
  - HT levels are essential for the source integrity. Having an HT ramp-down with RF on would have a severe impact on the source reliability if not its life time.
  - We should keep the interlock strategy as implemented until now.
  - So far, looking at past years statistics, one could not say it is worth a change.